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INTRODUCTION

Closed seasons as a management technique can be used to either control the amount of fishing effort or to protect the reproductive stock (Gulland 1974). Fishery managers seem to have similar views as to the policy's success in accomplishing these goals on either biological or economic grounds. Gulland argues that little justification exists in theory, (except in a few special circumstances), for the introduction of closed seasons. He shows that special protection of mature or spawning fish may not be of any real conservation benefit, and that a better method of increasing the long-term average catch is to protect small fish below some optimum size at first capture. Although the prohibition of fishing during spawning periods is in principle a worthy objective, it is unlikely that it will have any real effect on future stocks given the enormous number of eggs that are produced by an individual. If a closed season is successful in building up a stock, additional catching capacity will likely be introduced to the fishery. Unless the open season is shortened again, the fishing mortality will ultimately tend to return to its original level. Once closed seasons are introduced they often must be continually extended to maintain the amount of fishing at the desired level. Gulland concludes that a conservation measure that results in ships being laid up for an increasing period during the year cannot be expected to lead to economic efficiency. Despite this, closed seasons continue to be put into effect, especially as an initial method of regulation. The policy's main advantage seems to be that it is easy to introduce and enforce, while conveying the psychological effect to the fishermen and administrators that something beneficial is being done.

Anderson (1977) takes a similar position on the economic benefits of a closed season, contending that if a major portion of a stock is available throughout the year, then a seasonal closure will merely cause fishing effort to be reallocated to other times, at a higher level than before. Thus, it may be economically inefficient to use this policy under these circumstances. Waugh (1984) expressed a similar viewpoint, stating that to be effective a management tool must be economically efficient (capable of insuring the greatest net contribution to the economy), flexible (changes in policy are quickly realized), and must be easy to be implement and enforce. Closed seasons, according to Waugh, meet the latter two criteria, but fail in economic efficiency as long as there is no further restriction on effort during the open fishing season. He argues that while effort may be restricted in one area, fishermen find ways to increase catch or avoid restrictions by increasing fishing power, using larger engines, bigger boats, more traps, or fishing longer hours per day. The fate of the fishermen during the period of closure must also be considered. Anderson asserts that as long as fishermen remain idle, that portion of their productive capacity is wasted. If the sustained yield of the fishery has been sufficiently increased by the decrease in effort, then a partial gain may be realized. In addition, if the labor and gear which have been released can be shifted to another underutilized fishery, then a net gain will result in the form of an increase in total production. If the effort is transferred into a fishery which is already overexploited, however, then the overall effect will be counterproductive. Additional benefits can be

achieved by performing vessel maintanence during periods of inactivity. Anderson concluded that a vital consideration in implementing any regulatory program must always be the weighing of its relative costs and benefits to determine whether a net gain will result.

In the following paragraphs I briefly review the history of closed season when used as a management technique in several lobster fisheries throughout the world. This discussion is framed to examine the success of closed seasons as an efficient management policy in terms of these relative gains and losses.

AUSTRALIA

Two separate closed seasons exist in the Western Australian spiny lobster fishery for Panulirus cygnus. The coastal fishery is closed from July 1 to November 30, while in the Abrolhos Islands fishing is prohibited from July 1 to March 14. Various modifications of this policy have occurred throughout the history of the fishery, beginning in 1897, as the amount of fishing effort has increased (Hancock 1981). The current closed season roughly corresponds to the peak breeding period for the species. Nonetheless, the amount of fishing effort (number of pot lifts) in the fishery has continued to increase, despite the implementation of limited entry in 1963. This has partly resulted from upgrading the fishing fleet (Bowen 1980). Consequently fishermen have operated on more days during the season. In a further attempt to control the growth of fishing effort the season was shortened by 6 weeks in 1977. This achieved a temporary reduction in pot lifts of 5%, but was mostly compensated for in later years (Hancock 1981). Bowen concluded that retrictions on gear, season, and area do not produce the same beneficial effects as reducing the number of vessels. Hancock adds that the closed season has played an important role in limiting fishing effort, although there has remained a considerable potential for actual increases in effort during the open season. Because of this potential for increase, a closed season alone is considered an inadequate method of reducing fishing effort in the Western Australian lobster fishery (Bowen 1980).

FLORIDA

A closed harvest season for the spiny lobster P. argus was established in Florida in 1919. This was designed to coincide with the period of maximum spawning activity, which occurs from March to July (Simmons 1978). Peak spawning occurs during this time, although some reproductive activity takes place throughout the year. The original closed season extended from March 1 to June 1, but was changed in 1965 to April 1-July 25. It is interesting to note that closed season and a minimum size restriction were the only management measures imposed until 1965. Unfortunately, poor catch statistics up to that time preclude any assessment of the effectiveness of these measures. In Florida nearly all legal lobsters are harvested each year, prompting Davis (1981) to contend that Florida's present closed season policy is beneficial biologically and economically. Due to intense fishing effort, any significant spawning can only occur during the closed period and thus very few animals have more then one opportunity to spawn.

Davis (1981) concluded that without a closed season nearly all current spawners would be harvested before reaching maturity. This problem is compounded due to the uncertainty of the origin of Florida's recruited post-larvae. It has been suggested that the Florida stock may originate from the western Caribbean via the Yucatan Channel (Lyons 1981). If true, then Florida recruitment depends little on Florida spawn. Nevertheless, Lyons argued for a closed season on the grounds that it allows replenishment by growth of the next emerging year class, thus allowing the stocks to recover to a higher level as the new season opens. In addition, the 4-month closed season may protect the spawn of other fisheries that may depend on Florida larvae and upon whose larvae Florida may depend. Evidently, in an extremely overcapitalized fishery such as that found in Florida, a closed season may be a viable alternative in lieu of any other effective management programs.

CALIFORNIA

A closed season from May 15 to July 15 and a minimum size restriction of 0.45 kg (1 lb) was imposed in the California spiny lobster fishery in 1894. Before this fishery was unregulated. The spawning season for P. interruptus extends from April to September, and there is a peak in spawning between May and July (Lindberg 1955). The closed season has been modified several times throughout the history of the fishery in further attempts to control effort and prevent overfishing. The current closed season lasts from March 16 to September 30. Lindberg recommended that the present closed season be maintained on the grounds that it adequately protected berried (ovigerous) females, but concluded that it could not be defended except as arbitrary or experimental. Before 1965 detailed lobster catch statistics were unavailable. Consequently, the effect of these early management measures is poorly known. Beginning with the 1965-66 season the California Department of Fish and Game (CDFG) began issuing permits to all lobster fishermen and during this season 345 permits were issued (Odemar et al. 1975) and by the 1969-70 season the number of fishermen stood at 540. The following year a $100.00-fee was charged for the permit and 180 fishermen applied. Log books were issued during the 1973-74 season, resulting in the best catch statistics to date. It became apparent that catch per unit of effort (CPUE) was decreasing and that the stocks were in a state of decline. These improved catch statistics led Odemar et al. (1975) to conclude that the most important factor in the continued decline of lobster stocks was the take of undersize lobsters. In an effort to help alleviate this problem, escape vents are now required in all lobster traps fished in Californinia. Reduction of stocks due to excess fishing pressure was also recognized as a factor. With the recent availability of accurate catch statistics from the log book data set, CDFG is examining other options such as limited entry, area quotas, and gear limitation as methods of reducing fishing effort.

NEW ZEALAND

The spawning season in New Zealand for the spiny lobster Jasus edwardsii runs from April to October, although some spawning occurs throughout the year (Annala 1983). Commercial diving for lobsters is

prohibited from March 1 to April 30. Lobster trapping has been prohibited at the Chatham Island area from March 1 to April 30 since 1977. Otherwise, no other closed season policy exists in New Zealand, despite the fact that the lobster fishery has been the most important domestic fishery since the mid 1950's, both in terms of landings and the numbers of vessels and fishermen employed. A biological off season exists in most areas, which extends from late February or early March to June or July. During this period most mature females are molting or mating and are much less likely to enter traps. Other management measures in effect besides closed season include minimum size limits, prohibition on the taking of berried females and soft shelled lobsters, closed areas, and the requirement that escape vents be used in all traps (Annala 1983). A form of limited entry in which a maximum number of licenses is granted for each of 10 fishing areas has been in effect since 1980. Before this the average annual landings per vessel had declined steadily since the mid 1960's. Annual landings have stabilized at 4,500-4,600 metric tons from 1979 to 1981, due in part to the implementation of this limited entry policy along with a more stringent catch reporting requirement. Consequently, a closed season has not played a major role in the management of the New Zealand lobster fishery.

SOUTH AFRICA

A closed season has been in effect since 1971 for South Africa's major species of spiny lobster, J. lalandii. Fishing is prohibited along the entire coast of southwest Africa from July 1 to December 30 (Beyers 1979). This corresponds roughly to the spawning period of this species which extends from May to October. Peak spawning is said to occur from June to September, and some reproductive activity occurs throughout the year (Heydorn 1969). Variations in spawning season and fishing season exist in other coastal areas of South Africa, but all follow a similar pattern in that the closed season is centered around the time of peak spawning. Little quantitative data exist concerning the success of the South African closed season policy. Annual production quotas for individual fishing regions appear to be the primary method of management. These quotas can be adjusted upward or downward at any time, depending on the condition of the stocks. Since there is no provision preventing fishermen from moving from one region to another as various quotas are met, seasonal closures are used as a secondary method to restrict total fishing activity.

CANADA

A closed season, along with a minimum size restriction and a prohibition against retaining egg bearing females, were among the first management measures used in the Canadian lobster fishery for Homarus americanus. Fishing was initially prohibited for the months of June-July in 1874 but was changed several times between 1874 and 1887 (DeWolf 1974). The length of the season also varied between provinces. Initially closed seasons were used to prevent lobsters that were in poor condition from being canned. By 1879 attempts were made to use the policy as a means of reducing fishing effort. Up to that time little consideration was given to the spawning season of the animal. Closed season was changed in 1887 to July 1-December 31 and was the first attempt to restrict harvest

specifically during the spawning season. Modifications have occurred in the season since that time, mostly due to the demands of the canning industry. As of 1971, seven different closed seasons were in effect throughout Canada's provinces. The average open season lasts only 2-3 months, although some landings are reported year-round. Again, the closed seasons reflect the spawning season in each respective area. DeWolf (1974) contends that as a method of protecting reproductive stock, closed seasons in Canada may have had some beneficial effects. As a method of increasing or maintaining sustained yield by reducing fishing effort, however, he believes it has failed, concluding that closed seasons must be used in conjunction with other effort reducing measures (trap limits, license limitation) to be more effective.

EUROPE

The lobster fishery in Europe for H. gammarus has existed for hundreds of years. As of 1981, most countries operated under an unrestricted free access type of fishery. Catch rates in many areas have decreased (Bennett 1981). Closed seasons are now maintained in Portugal, Spain, Germany, Norway, and Sweden. Portugal and Spain utilize the closed season during the winter period of low fishing activity. The other countries have a 3-month closed season centered around summer. England, Scotland, Northern Ireland, Ireland, and France do not utilize closed seasons. A natural closed season exists in all areas during winter, the result of inclement weather and reduced catchability due to the inactivity of the lobsters because of cold water temperatures. Two of the countries use the policy for specific purposes. In Norway the closed season during the spawning period is used to protect spawning stock and recent molters. Sweden maintains a closed season to protect spawners and to reduce recreational fishing. A limitation on the amount of traps that can be set per season is also used in Sweden as a management measure. Most of the other countries use a minimum landing size as the only other major method of management. Bennett maintains that any effective management strategy for Europe must include a control on fishing effort and adds that "closed seasons have very little value in directly controlling fishing effort, unless coupled with other effort controls". He concludes that the most effective way to control effort in the European lobster fishery is by limited entry and vessel licensing.

MAIN HAWAIIAN ISLANDS

The spiny lobster fishery in the main Hawaiian Islands has been an incidental or recreational fishery since World War II (Western Pacific Regional Fishery Management Council 1981). Nets, traps, and scuba are used in the commercial fishery, although as of 1981, no commercial fishermen were known to concentrate solely on spiny lobsters. Hawaii has maintained a closed season for this fishery since 1925. Fishing is prohibited for P. marginatus and P. penicillatus in the main Hawaiian Islands during June, July, and August. It has been shown that these species spawn year-round in this area; there are spawning peaks in January, April, June, July, and October (Morris 1968). Thus the closed season may prevent fishing during some of these peak spawning months. More importantly, a restriction on

fishing during the summer months is believed to limit the tremendous recreational fishery that exists there. It is thought that the recreational catch in Hawaii may be at least equivilent to the commercial catch (McGinnis 1972). Other management measures used here include minimum size restrictions and a prohibition on the retention of berried females. Despite these restrictions, reported commercial landings have declined from a high of 19.8 metric tons (43,632 lb) in 1949 to 2.0 metric tons (4,467 lb) in 1974. A portion of this decline may have been offset by an increase in the unreported recreational catch during the open fishing season. To date no accurate information exists as to the true extent of the recreational fishery. Until more detailed information becomes available concerning total landings for the main Hawaiian Islands it will be difficult to assess the effectiveness of any management measure.

CONCLUSION

The closed season as a management policy has been used by most major lobster fisheries throughout the world in an attempt to (1) restrict fishing effort and (2) prohibit fishing during spawning season. Little data are available to substantiate the effectiveness of this policy in accomplishing either of these goals. In most cases, a closed season is used as an initial method of regulating the fishery, and is then retained because of the ease of implementation and enforceability. Seasonal closure in fisheries where spawning is highly seasonal may to some extent be successful in protecting reproductive stock, although any net benefit attained could be negated if effort is allowed to increase at other times of the year. The major consensus of opinion is that closed seasons do little to actually control fishing effort unless effort is restricted by some other means during the open season.

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